(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 259 370 A3

(12) EUROPEAN PATENT APPLICATION

(88) Date of publication A3:
12.01.2011 Bulletin 2011/02

(43) Date of publication A2:
08.12.2010 Bulletin 2010/49

(21) Application number: **10164915.0**

(22) Date of filing: **04.06.2010**

(51) Int Cl.:
H01M 4/36 *(2006.01)*

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR
Designated Extension States:
BA ME RS

(30) Priority: **05.06.2009 KR 20090050053**

(71) Applicant: **SB LiMotive Co., Ltd.**
Yongin-si
Gyeonggi-do (KR)

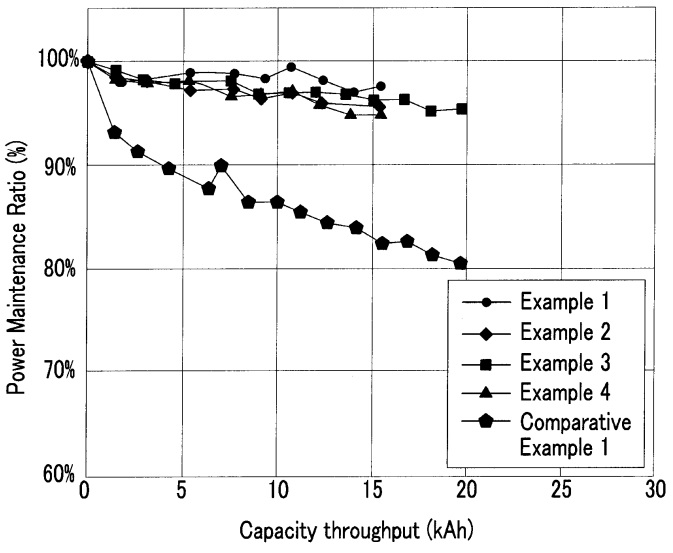
(72) Inventors:
- **YANG, Chun-Mo**
  Gyeonggi-do (KR)
- **KASAI, Masahiro**
  Gyeonggi-do (KR)
- **KIM, Sung-Hoon**
  Gyeonggi-do (KR)

(74) Representative: **Gulde Hengelhaupt Ziebig & Schneider**
Patentanwälte - Rechtsanwälte
Wallstrasse 58/59
10179 Berlin (DE)

(54) Active material and positive electrode for rechargeable lithium battery and rechargeable lithium battery including the positive electrode

(57) A positive electrode for a rechargeable lithium battery includes a first positive active material represented by $Li_aNi_bCo_cM_dO_2$, and a second positive active material represented by $Li_eNi_fCo_gMn_hO_2$, whereby M is selected from Al, B, Cr, Fe, Mg, Sr, and V, $0.95 \leq a \leq 1.1$, $0.5 \leq b \leq 0.9$, $0 < c \leq 0.3$, $0 \leq d \leq 0.1$, $0.95 \leq e \leq 1.1$, $0.33 \leq f \leq 0.5$, $0.15 \leq g \leq 0.33$, and $0.3 \leq h \leq 0.35$. A rechargeable lithium battery includes the positive electrode, a negative electrode and an electrolyte.

FIG.1



EP 2 259 370 A3

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 10 16 4915

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	JP 2008 135245 A (SANYO ELECTRIC CO) 12 June 2008 (2008-06-12) * paragraph [0011] * * paragraph [0027] - paragraph [0030]; tables 1,2 *	1-9	ADD. H01M4/36
X	JP 2008 117611 A (GS YUASA CORP) 22 May 2008 (2008-05-22) * paragraphs [0051], [0 52]; claim 2; table 1 * * paragraph [0075] *	1,2,5-9	
X	US 2007/015058 A1 (TAKEZAWA HIDEHARU [JP] ET AL) 18 January 2007 (2007-01-18) * paragraph [0079] - paragraph [0080] * * paragraph [0079] - paragraph [0080] * * paragraph [0081] - paragraph [0082] * * paragraph [0100] - paragraph [0101] * * paragraph [0116] - paragraph [0117] *	1-9	
X	US 2006/234115 A1 (WATANABE KOZO [JP] ET AL) 19 October 2006 (2006-10-19) * paragraph [0076] * * paragraph [0088] - paragraph [0090]; tables 1,2 *	1-9	TECHNICAL FIELDS SEARCHED (IPC) H01M
X	US 2009/087740 A1 (DEGUCHI MASAKI [JP] ET AL) 2 April 2009 (2009-04-02) * paragraphs [0076], [0077] * * paragraph [0088] - paragraph [0089]; table 5 *	1-9	
X	WO 2008/123011 A1 (TODA KOGYO CORP [JP]; KIKUYA KAZUHIKO [JP]; SASAKI OSAMU [JP]; SANTOKI) 16 October 2008 (2008-10-16) * abstract *	1-9	

-/--

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	2 December 2010	Maxisch, Thomas

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

3

EPO FORM 1503 03.82 (P04C01)

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 10 16 4915

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X,P	& EP 2 128 915 A1 (TODA KOGYO CORP [JP]) 2 December 2009 (2009-12-02) * table 1 * * paragraph [0074] - paragraph [0084] * * paragraph [0091] - paragraph [0094] * * paragraph [0009] - paragraph [0010] * * as translation of WO document *	1-9	
A	US 2006/216601 A1 (KOMIYAMA MICHIKO [JP] ET AL) 28 September 2006 (2006-09-28) * paragraph [0091] - paragraph [0096]; tables 7, 8 *	1,2,5-9	
A	JP 2007 265731 A (HITACHI MAXELL) 11 October 2007 (2007-10-11) * abstract; examples 1,14 *	1-9	
A	EP 1 465 271 A1 (SONY CORP [JP]) 6 October 2004 (2004-10-06) * page 21; example 13; table 1 * * paragraph [0008] * * paragraph [0020] - paragraph [0025] *	1-9	TECHNICAL FIELDS SEARCHED (IPC)
A	JP 2005 026141 A (MATSUSHITA) 27 January 2005 (2005-01-27) * abstract; tables 1,3-6 *	1-9	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	2 December 2010	Maxisch, Thomas

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

Europäisches Patentamt
European Patent Office
Office européen des brevets

Application Number
EP 10 16 4915

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☒ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).

Europäisches Patentamt
European Patent Office
Office européen des brevets

LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 10 16 4915

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 3(completely); 1, 2, 4-9(partially)

A positive electrode for a rechargeable lithium battery includes a first positive active material represented by LiaNibCocMd02, and a second positive active material represented by LieNifCogMnh02. M is selected from AI and B, 0.95 <=a<=1.1, 0.5<=b<=0.9, 0<c<=0.3, 0<d<=0.1, 0.95<=e<=1.1, 0.33<=f<=0.5, 0.15<=g<= 0.33, and 0.3 <= h <= 0.35.

---

2. claims: 1, 2, 4-9(all partially)

A positive electrode for a rechargeable lithium battery includes a first positive active material represented by LiaNibCocMd02, and a second positive active material represented by LieNifCogMnh02. M is selected from Cr, Fe, and V, 0.95 <=a<=1.1, 0.5<=b<=0.9, 0<c<=0.3, 0<d<=0.1, 0.95<=e<=1.1, 0.33<=f<=0.5, 0.15<=g<= 0.33, and 0.3 <= h <= 0.35.

---

3. claims: 1, 2, 4-9(all partially)

A positive electrode for a rechargeable lithium battery includes a first positive active material represented by LiaNibCocMd02, and a second positive active material represented by LieNifCogMnh02. M is selected fromMg and Sr, 0.95 <=a<=1.1, 0.5<=b<=0.9, 0<c<=0.3, 0<d<=0.1, 0.95<=e<=1.1, 0.33<=f<=0.5, 0.15<=g<= 0.33, and 0.3 <= h <= 0.35.

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 10 16 4915

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

02-12-2010

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2008135245 A	12-06-2008	NONE	
JP 2008117611 A	22-05-2008	NONE	
US 2007015058 A1	18-01-2007	CN 1897331 A	17-01-2007
		KR 20070009447 A	18-01-2007
US 2006234115 A1	19-10-2006	CN 1848483 A	18-10-2006
		JP 2006294512 A	26-10-2006
		US 2010040940 A1	18-02-2010
US 2009087740 A1	02-04-2009	CN 101268581 A	17-09-2008
		WO 2007007636 A1	18-01-2007
		KR 20080017483 A	26-02-2008
WO 2008123011 A1	16-10-2008	CA 2680192 A1	16-10-2008
		CN 101622741 A	06-01-2010
		EP 2128915 A1	02-12-2009
		JP 4258676 B2	30-04-2009
		JP 2008251532 A	16-10-2008
		JP 2009117369 A	28-05-2009
		KR 20090120469 A	24-11-2009
		US 2010099027 A1	22-04-2010
US 2006216601 A1	28-09-2006	CN 1832231 A	13-09-2006
		JP 4273422 B2	03-06-2009
		JP 2006252894 A	21-09-2006
		KR 20060097630 A	14-09-2006
JP 2007265731 A	11-10-2007	NONE	
EP 1465271 A1	06-10-2004	CN 1515041 A	21-07-2004
		WO 03063275 A1	31-07-2003
		US 2009029254 A1	29-01-2009
		US 2004076882 A1	22-04-2004
JP 2005026141 A	27-01-2005	JP 4374930 B2	02-12-2009

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82